alternative to sterilisation put forward by Dr. Houston in his reports to the Metropolitan Water Board—namely, adequate storage followed by efficient filtration—is not presented in its best light, and one is inclined to think a much better case could be made out from Dr. Houston's reports in favour of his suggestions than is conveyed by the somewhat meagre extracts given in the book.

The different means of sterilising water are very fully described and discussed, both chemical (peroxides, excess lime, chlorine, and hypochlorites, etc.), and physical and electrical (electrolytic hypochlorite, ozone, and ultra-violet light), and full reference is made to the places where these processes are practised.

The concluding chapter, on the analysis of water and the interpretation of results, is written more for the water authority than the analyst. It is not an easy subject to deal with, yet the authors appear to have done it very carefully.

There are numerous excellent plates in the book illustrating different works and processes.

DENISON B. BYLES.

RADIOLOGY IN THEORY AND PRACTICE.

(1) *X-rays: an Introduction to the Study of Röntgen Rays.* By Dr. G. W. C. Kaye. Pp. x+252. (London: Longmans, Green and Co., 1914.) Price 5*s*. net.

(2) *A Manual of X-Ray Technic.* By Capt. A. C. Christie. Pp. viii+104. (Philadelphia and London: J. B. Lippincott Company, n.d.) Price 8*s*. 6*d*. net.

(3) *Molecular Physics.* By J. A. Crowther. Pp. viii+167. (London: J. and A. Churchill, 1914.) Price 3*s*. 6*d*. net.

(1) THE discovery of X-rays has hitherto afforded an opportunity, probably unique in the history of science, for the production of that kind of literature which is distinguished more for its sensational character than for its accuracy or usefulness. If the numerous small books and pamphlets dealing with the subject and published between 1895 and 1898 do not seem to us now to possess any striking feature, they are at least remarkable for their resemblance to one another. They serve, too, as a measure of the wide popular interest aroused by Prof. Röntgen's work. Some of these publications actually reached the six thousandth edition before finally sinking into oblivion. When it was realised, however, that X-rays, in conjunction with the study of radioactivity, were destined to play a vital part in the elucidation of many problems hitherto considered insoluble, and a few well-known laboratories had successfully taken the matter in hand, the budding heralds of a new physics seem to have lost their spirit. It is noteworthy that from about 1898 until now, excepting some medical works, including an account of radiation treatment, no English book has appeared devoted solely to the systematic study of Röntgen radiation.

Dr. Kaye's book will therefore be welcomed by all who are engaged in work with the new radiations generally and with X-rays in particular, for it has appeared at the very moment when it is most needed.

The time has certainly come to take stock of our knowledge of this subject and to set forth clearly the relationship which connects the speed of the electron with the wave-length of the radiation resulting from its impact against a specific substance. Incidentally, it is seen that the production of a radiation identical with the gamma rays from radium is merely a question of overcoming certain experimental difficulties, and obstacles of this character generally disappear with the lapse of time. The first part of Dr. Kaye's book deals in an interesting manner with some of the early classical vacuum-tube experiments, and care is taken, by the aid of numerous asides in the form of footnotes, to give the reader many useful facts as well as references.

The fourth chapter deals with the X-ray bulb itself, and the progressive changes in its design are traced from the 1895 type, with flat electrodes, up to the somewhat elaborate modern apparatus. There are many excellent illustrations here, and the photomicrograph on p. 43, of an anti-kathode after prolonged use, is of great interest. A chapter follows in which the various high-potential generators of electricity are described. The references to influence machines, induction coils, and step-up transformers contain many practical hints, and the oscillograph records are well reproduced. Next follows an account of the various interrupters and their several virtues or drawbacks, and a chapter dealing with the actual manipulation of an X-ray apparatus, wherein we are told about the volatilisation of the anti-kathode, the coloration of the glass, and so forth—all of great practical interest and importance to these engaged upon this work. The rest of the book is concerned with the more theoretical part of the subject and methods of measurement, questions of wave-length, sparking potentials, absorption coefficients, and so on. The work of Barkla and others on the secondary and characteristic radiations are fully set out, so that the reader may be gradually prepared for the final sections dealing with the actual nature of X-rays and the

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discussion of recent work upon their reflection from the interior of crystals.

Although we do not agree with the footnote to p. 165, the application of X-rays to medicine is mentioned with a moderation which will be understood and appreciated by those who are expert in that branch of the subject. We have no hesitation in recommending that a copy of the book should be in the library of every medical practitioner who desires to master the fundamental ideas underlying the properties and actions of the radiation which he is putting to good use in the alleviation or cure of disease.

(2) The study of the clinical application of X-rays is more often than not approached from a purely medical point of view, and some there are who think that a wider scientific knowledge, especially of physics, should play a large part in the early training of the student of radiology. It is probable that with them at least this book will find no favour; indeed, were it not for the fact that the author states specifically in his preface, for whom this book is intended some doubt upon the point might reasonably have arisen.

It must be borne in mind, however, that we have to deal here with a manual intended to meet the "needs of the United States army," and, judging by the somewhat limited knowledge of the subject considered sufficient in our own service, a student who assimilates the contents of this work might be counted as one possessing exceptional qualifications.

If "brevity is the soul of wit," it may also be the source of much error, and the inadequate treatment of the elements of electricity and magnetism condensed into the first nine pages contains some misleading statements. From chapter iii. onwards, however, there will be found many useful practical hints as to radiographic technique, and the tersely written survey (which certainly covers a wide field) affords a suitable framework upon which to build by experience if supplemented by the study of more complete works dealing with the subject.

(3) It is noteworthy that in this small handy volume Mr. Crowther has succeeded in giving a remarkably complete survey of work dealing with the physics of the electron and atomic structure.

The treatment of the subject is naturally influenced very largely by the trend of researches carried out during the last few years at the Cavendish Laboratory, and the work therefore stands as an authoritative and connected account of the most important recent results which have emanated from Cambridge under the stimulating leadership of Prof. Sir J. J. Thomson. The new method of analysis, for instance, which depends upon the simultaneous deviation of positive particles by an electrostatic and magnetic field, is dealt with in considerable detail and the apparatus illustrated by photograph and diagrams. There are also chapters devoted to the nature and size of electrons, their group stability, cohesion, and adhesion, as well as the bearing of modern physics upon valency and other problems once thought to be the exclusive preserves of the chemist. In the midst of great detail the author has nevertheless marked out clearly the general lines upon which this important subject has rapidly developed in recent years, and has brought together into a connected whole the results of work from many sources. It is difficult to select any particular section for special mention where all are so well done, but the chapter dealing with the atom in vibration is certainly of particular interest.

The author then shows the far-reaching significance of these new experimental results by directing attention to their bearing upon the complex "molecular theory of matter" as applied to solids, liquids, and gases. In the later pages he refers to the kinetic theory of heat, the size of atoms, and many other questions of wide interest and importance at the present day. The book, so well conceived, is a veritable mine of information. It will be read by physicists with only one regret—the author has not included even the briefest index. C. E. S. P

OUR BOOKSHELF.

Economic Cycles: Their Law and Cause. By Prof. H. L. Moore. Pp. viii + 149. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1914.) Price 8*s.* 6*d.* net.

IN this volume Prof. Moore has undertaken to test statistically the theory that the fundamental cause of that curious swing in trade, which results in alternate periods of depression and expansion instead of steady growth or decline, is a corresponding cycle in the weather, operating through its effect on the crops. Rainfall data for the Ohio valley are subjected to harmonic analysis, and the periodogram shows principal periods of thirty-three and eight years. These periods and their semiharmonics applied to the statistics of yield and production for some of the principal crops suggest that they will also account for the principal fluctuations in quantity, as might be expected from the high correlation between the yield and the rainfall of the months that are critical for each crop. Changes in yield are also highly correlated with changes in price for the several crops, and hence the general relation of the crop-cycle to the cycle of prices and trade in general—though matters are not so simple as might be thought at first sight, for in some manufacturing industries, *e.g.*, the production of pig-iron, price and production rise and fall together.

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